

Topical questions | 40 questions

6 Let $\mathbf{A} = \begin{pmatrix} 2 & 0 \\ 1 & 1 \end{pmatrix}$.

- Find the value of d . [3]

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- $$\mathbf{A}^n = \begin{pmatrix} 2^n & 0 \\ 2^n - 1 & 1 \end{pmatrix}. \quad [5]$$

[illegible]

Topical questions | 40 questions

$$\mathbf{B} = \begin{pmatrix} 1 & 0 \\ 33 & 0 \end{pmatrix}.$$

[5]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The entire page is otherwise blank, with no margins, text, or other markings.

Topical questions | 40 questions

6 Let $\mathbf{A} = \begin{pmatrix} 2 & 0 \\ 1 & 1 \end{pmatrix}$.

- Find the value of d . [3]

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- $$\mathbf{A}^n = \begin{pmatrix} 2^n & 0 \\ 2^n - 1 & 1 \end{pmatrix}. \quad [5]$$

[illegible]

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

2. Question part 2/2 | 9231 May-June 2020 P1 V2 Q6

- (c) The line $y = 2x$ is invariant under the transformation in the x - y plane represented by $\mathbf{A}^n \mathbf{B}$, where

$$\mathbf{B} = \begin{pmatrix} 1 & 0 \\ 33 & 0 \end{pmatrix}.$$

Find the value of n .

[5]

[illegible]

Topical questions | 40 questions

4 The matrix $\mathbf{A}$ is given by

$$\mathbf{A} = \begin{pmatrix} k & 0 & 2 \\ 0 & -1 & -1 \\ 1 & 1 & -k \end{pmatrix},$$

(a) Show that $\mathbf{A}$ is non-singular. [3]

[illegible]
$$\mathbf{B} = \begin{pmatrix} 0 & -3 \\ -1 & 3 \\ 0 & 0 \end{pmatrix} \text{ and } \mathbf{C} = \begin{pmatrix} -3 & -1 & 1 \\ 1 & 1 & 2 \end{pmatrix}.$$

It is given that $\mathbf{CAB} = \begin{pmatrix} -2 & -\frac{3}{2} \\ -1 & -\frac{3}{2} \end{pmatrix}$.

(b) Find the value of k . [3]

[illegible]

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

3. Question part 2/2 | 9231 May-June 2020 P1 V3 Q4

- (c) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by **CAB**. [5]

[illegible]

Topical questions | 40 questions

1 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} 1 & b \\ 0 & 1 \end{pmatrix} \begin{pmatrix} a & 0 \\ 0 & 1 \end{pmatrix}$, where a and b are positive constants.

State the type of each transformation, and make clear the order in which they are applied. [2]

(b) Find, in terms of a and b , the matrix which transforms parallelogram $OPQR$ onto the unit square. [2]

[illegible]

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

4. Question part 2/2 | 9231 Oct-Nov 2020 P1 V1 Q1

It is given that the area of $OPQR$ is 2 cm^2 and that the line $x+3y=0$ is invariant under the transformation represented by $\mathbf{M}$.

(c) Find the values of a and b . [5]

[illegible]

4 The matrices **A** and **B** are given by

$$\mathbf{A} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \text{ and } \mathbf{B} = \begin{pmatrix} \frac{1}{2} & -\frac{1}{2}\sqrt{3} \\ \frac{1}{2}\sqrt{3} & \frac{1}{2} \end{pmatrix}.$$

(a) Give full details of the geometrical transformation in the x - y plane represented by **A**. [1]

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(b) Give full details of the geometrical transformation in the x - y plane represented by **B**. [2]

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The triangle DEF in the x - y plane is transformed by **AB** onto triangle PQR .

(c) Show that the triangles DEF and PQR have the same area. [3]

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Topical questions | 40 questions

(d) Find the matrix which transforms triangle PQR onto triangle DEF . [2]

- [illegible]

Topical questions | 40 questions

1 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} 1 & b \\ 0 & 1 \end{pmatrix} \begin{pmatrix} a & 0 \\ 0 & 1 \end{pmatrix}$, where a and b are positive constants.

- State the type of each transformation, and make clear the order in which they are applied. [2]

(b) Find, in terms of a and b , the matrix which transforms parallelogram $OPQR$ onto the unit square. [2]

[illegible]

Topical questions | 40 questions

It is given that the area of $OPQR$ is 2 cm^2 and that the line $x+3y=0$ is invariant under the transformation represented by $\mathbf{M}$.

(c) Find the values of a and b . [5]

[illegible]

$$\mathbf{A} = \begin{pmatrix} 5 & k \\ -3 & -4 \end{pmatrix}.$$

- (a) Find the value of k for which $\mathbf{A}$ is singular. [2]

[illegible]

It is now given that $k = 6$ so that $\mathbf{A} = \begin{pmatrix} 5 & 6 \\ -3 & -4 \end{pmatrix}$.

- (b)** Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by **A**. [6]

[illegible]

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- (c) The triangle DEF in the x - y plane is transformed by $\mathbf{A}$ onto triangle PQR .
- (i) Given that the area of triangle DEF is 10 cm^2 , find the area of triangle PQR . [2]

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- (ii) Find the matrix which transforms triangle PQR onto triangle DEF . [2]

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Topical questions | 40 questions

4 The matrix $\mathbf{M}$ represents the sequence of two transformations in the x - y plane given by a rotation of 60° anticlockwise about the origin followed by a one-way stretch in the x -direction, scale factor d ($d \neq 0$).

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

[illegible]

Topical questions | 40 questions

The matrix $\mathbf{N}$ is such that $\mathbf{MN} = \begin{pmatrix} 1 & 1 \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}$.

[illegible][illegible]

Topical questions | 40 questions

4 The matrix $\mathbf{M}$ represents the sequence of two transformations in the x - y plane given by a rotation of 60° anticlockwise about the origin followed by a one-way stretch in the x -direction, scale factor d ($d \neq 0$).

[illegible]

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Topical questions | 40 questions

The matrix $\mathbf{N}$ is such that $\mathbf{MN} = \begin{pmatrix} 1 & 1 \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}$.

[illegible][illegible]

Topical questions | 40 questions

4 The matrices **A**, **B** and **C** are given by

where k is a real constant.

[illegible][illegible]

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

10. Question part 2/2 | 9231 May-June 2021 P1 V3 Q4

- (c) Using the value of k from part (b), find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by **CAB**. [5]

[illegible]

Topical questions | 40 questions

4 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{pmatrix} \begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$.

- State the type of each transformation, and make clear the order in which they are applied. [2]

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11. Question part 2/2 | 9231 Oct-Nov 2021 P1 V1 Q4

[illegible]

Topical questions | 40 questions

12. Question | 9231 Oct-Nov 2021 P1 V2 Q1

- 1 (a) Give full details of the geometrical transformation in the x - y plane represented by the matrix $\begin{pmatrix} 6 & 0 \\ 0 & 6 \end{pmatrix}$. [1]

Let $\mathbf{A} = \begin{pmatrix} 3 & 4 \\ 2 & 2 \end{pmatrix}$.

- (b) The triangle DEF in the x - y plane is transformed by $\mathbf{A}$ onto triangle PQR .
- Given that the area of triangle DEF is 13 cm^2 , find the area of triangle PQR . [2]

- (c) Find the matrix $\mathbf{B}$ such that $\mathbf{AB} = \begin{pmatrix} 6 & 0 \\ 0 & 6 \end{pmatrix}$. [2]

- (d) Show that the origin is the only invariant point of the transformation in the x - y plane represented by $\mathbf{A}$. [4]

Topical questions | 40 questions

4 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{pmatrix} \begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$.

- State the type of each transformation, and make clear the order in which they are applied. [2]

[illegible]

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

13. Question part 2/2 | 9231 Oct-Nov 2021 P1 V3 Q4

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Topical questions | 40 questions

7 The matrix $\mathbf{A}$ is given by $\mathbf{A} = \begin{pmatrix} 1 & 2 & 3 \\ 4 & k & 6 \\ 7 & 8 & 9 \end{pmatrix}$.

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- This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

14. Question part 2/4 | 9231 May-June 2022 P1 V1 Q7

(c) Given that $\mathbf{B} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$, give an example of a matrix $\mathbf{C}$ such that $\mathbf{BAC} = \begin{pmatrix} 2 & 1 \\ k & 4 \end{pmatrix}$. [4]

This image shows a full page of a worksheet designed for handwriting practice. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for writing. The lines are evenly spaced across the entire page, providing a guide for letter height and placement. There is no text or other markings on the page.

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

14. Question part 3/4 | 9231 May-June 2022 P1 V1 Q7

- (d) Find the set of values of k for which the transformation in the x - y plane represented by $\begin{pmatrix} 2 & 1 \\ k & 4 \end{pmatrix}$ has two distinct invariant lines through the origin. [6]

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9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

14. Question part 4/4 | 9231 May-June 2022 P1 V1 Q7

Additional page

If you use the following page to complete the answer to any question, the question number must be clearly shown.

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9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

15. Question part 1/4 | 9231 May-June 2022 P1 V2 Q7

7 The matrix $\mathbf{A}$ is given by $\mathbf{A} = \begin{pmatrix} 1 & 2 & 3 \\ 4 & k & 6 \\ 7 & 8 & 9 \end{pmatrix}$.

(a) Find the set of values of k for which $\mathbf{A}$ is non-singular. [3]

(b) Given that $\mathbf{A}$ is non-singular, find, in terms of k , the entries in the top row of $\mathbf{A}^{-1}$. [4]

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Topical questions | 40 questions

15. Question part 2/4 | 9231 May-June 2022 P1 V2 Q7

(c) Given that $\mathbf{B} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$, give an example of a matrix $\mathbf{C}$ such that $\mathbf{BAC} = \begin{pmatrix} 2 & 1 \\ k & 4 \end{pmatrix}$. [4]

[illegible]

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

15. Question part 3/4 | 9231 May-June 2022 P1 V2 Q7

- (d) Find the set of values of k for which the transformation in the x - y plane represented by $\begin{pmatrix} 2 & 1 \\ k & 4 \end{pmatrix}$ has two distinct invariant lines through the origin. [6]

[illegible]

Topical questions | 40 questions

5 Let $\mathbf{A} = \begin{pmatrix} 1 & a \\ 0 & 1 \end{pmatrix}$, where a is a positive constant.

$$\mathbf{A}^n = \begin{pmatrix} 1 & na \\ 0 & 1 \end{pmatrix}. \quad [5]$$
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9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

16. Question part 2/2 | 9231 May-June 2022 P1 V3 Q5

Let $\mathbf{B} = \begin{pmatrix} b & b \\ a^{-1} & a^{-1} \end{pmatrix}$, where b is a positive constant.

- (c) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by $\mathbf{A}''\mathbf{B}$. [6]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

Topical questions | 40 questions

17. Question part 1/2 | 9231 Oct-Nov 2022 P1 V1 Q5

5 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} \frac{1}{2}\sqrt{2} & -\frac{1}{2}\sqrt{2} \\ \frac{1}{2}\sqrt{2} & \frac{1}{2}\sqrt{2} \end{pmatrix} \begin{pmatrix} 1 & k \\ 0 & 1 \end{pmatrix}$, where k is a constant.

(a) The matrix $\mathbf{M}$ represents a sequence of two geometrical transformations.

State the type of each transformation, and make clear the order in which they are applied. [2]

[illegible]

(b) The triangle ABC in the x - y plane is transformed by $\mathbf{M}$ onto triangle DEF .

Find, in terms of k , the single matrix which transforms triangle DEF onto triangle ABC . [2]

[illegible]

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

17. Question part 2/2 | 9231 Oct-Nov 2022 P1 V1 Q5

- (c) Find the set of values of k for which the transformation represented by $\mathbf{M}$ has no invariant lines through the origin. [7]

[illegible]

Topical questions | 40 questions

18. Question part 1/2 | 9231 Oct-Nov 2022 P1 V2 Q3

- 3** The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} 1 & 0 \\ 0 & k \end{pmatrix} \begin{pmatrix} 1 & 0 \\ k & 1 \end{pmatrix}$, where k is a constant and $k \neq 0$ or 1 .

State the type of each transformation, and make clear the order in which they are applied. [2]

[2]

[illegible]

(c) Show that the invariant points of the transformation represented by $\mathbf{M}$ lie on the line $y = \frac{k^2}{1-k}x$.

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Topical questions | 40 questions

18. Question part 2/2 | 9231 Oct-Nov 2022 P1 V2 Q3

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- (d) The triangle ABC in the x - y plane is transformed by $\mathbf{M}$ onto triangle DEF .

Find the value of k for which the area of triangle DEF is equal to the area of triangle ABC . [2]

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Topical questions | 40 questions

5 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} \frac{1}{2}\sqrt{2} & -\frac{1}{2}\sqrt{2} \\ \frac{1}{2}\sqrt{2} & \frac{1}{2}\sqrt{2} \end{pmatrix} \begin{pmatrix} 1 & k \\ 0 & 1 \end{pmatrix}$, where k is a constant.

- State the type of each transformation, and make clear the order in which they are applied. [2]

[illegible]

- Find, in terms of k , the single matrix which transforms triangle DEF onto triangle ABC . [2]

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9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

19. Question part 2/2 | 9231 Oct-Nov 2022 P1 V3 Q5

- (c) Find the set of values of k for which the transformation represented by $\mathbf{M}$ has no invariant lines through the origin. [7]

[illegible]

Topical questions | 40 questions

4 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} a & b^2 \\ c^2 & a \end{pmatrix}$, where a, b, c are real constants and $b \neq 0$.

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It is given that **M** represents the sequence of two transformations in the x – y plane given by an enlargement, centre the origin, scale factor 5 followed by a shear, x -axis fixed, with $(0, 1)$ mapped to $(5, 1)$.

(c) Find **M**. [3]

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(d) The triangle DEF in the x – y plane is transformed by **M** onto triangle PQR .
Given that the area of triangle DEF is 12 cm^2 , find the area of triangle PQR . [2]

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9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

21. Question part 1/2 | 9231 May-June 2023 P1 V2 Q4

4 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} a & b^2 \\ c^2 & a \end{pmatrix}$, where a, b, c are real constants and $b \neq 0$.

(a) Show that $\mathbf{M}$ does not represent a rotation about the origin.

[2]

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(b) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by $\mathbf{M}$. [5]

[illegible]

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It is given that **M** represents the sequence of two transformations in the x – y plane given by an enlargement, centre the origin, scale factor 5 followed by a shear, x -axis fixed, with $(0, 1)$ mapped to $(5, 1)$.

(c) Find **M**. [3]

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(d) The triangle DEF in the x – y plane is transformed by **M** onto triangle PQR .
Given that the area of triangle DEF is 12 cm^2 , find the area of triangle PQR . [2]

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Topical questions | 40 questions

4 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} \cos 2\theta & -\sin 2\theta \\ \sin 2\theta & \cos 2\theta \end{pmatrix} \begin{pmatrix} 1 & k \\ 0 & 1 \end{pmatrix}$, where $0 < \theta < \pi$ and k is a non-zero constant. The matrix $\mathbf{M}$ represents a sequence of two geometrical transformations, one of which is a shear.

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- [illegible]

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- This image shows a full page of white paper with ten horizontal dashed lines, evenly spaced from top to bottom. The lines are thin and black, typical of handwriting practice paper. There is no text or other markings on the page.

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Topical questions | 40 questions

22. Question part 2/2 | 9231 May-June 2023 P1 V3 Q4

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- (d) Given that $k = 2\sqrt{3}$ and $\theta = \frac{1}{3}\pi$, show that the invariant points of the transformation represented by $\mathbf{M}$ lie on the line $3y + \sqrt{3}x = 0$. [4]

[illegible]

Topical questions | 40 questions

23. Question part 1/2 | 9231 Oct-Nov 2023 P1 V1 Q5

5 Let k be a constant. The matrices **A**, **B** and **C** are given by

$$\mathbf{A} = \begin{pmatrix} 1 & k & 3 \\ 2 & 1 & 3 \\ 3 & 2 & 5 \end{pmatrix}, \quad \mathbf{B} = \begin{pmatrix} 0 & -2 \\ -1 & 3 \\ 0 & 0 \end{pmatrix} \quad \text{and} \quad \mathbf{C} = \begin{pmatrix} -2 & -1 & 1 \\ 1 & 1 & 3 \end{pmatrix}.$$

It is given that $\mathbf{A}$ is singular.

(a) Show that $\mathbf{CAB} = \begin{pmatrix} 3 & -7 \\ -9 & 3 \end{pmatrix}$. [5]

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(b) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by **CAB**. [5]

[illegible]

Topical questions | 40 questions

- **D** represents an enlargement, centre the origin.
- **E** represents a stretch parallel to the x -axis.
- **F** represents a reflection in the line $y = x$.

[illegible]

Topical questions | 40 questions

3 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} k & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$, where k is a constant and $k \neq 0$ and $k \neq 1$.

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- [illegible]

Topical questions | 40 questions

25. Question part 1/2 | 9231 Oct-Nov 2023 P1 V3 Q5

5 Let k be a constant. The matrices **A**, **B** and **C** are given by

$$\mathbf{A} = \begin{pmatrix} 1 & k & 3 \\ 2 & 1 & 3 \\ 3 & 2 & 5 \end{pmatrix}, \quad \mathbf{B} = \begin{pmatrix} 0 & -2 \\ -1 & 3 \\ 0 & 0 \end{pmatrix} \quad \text{and} \quad \mathbf{C} = \begin{pmatrix} -2 & -1 & 1 \\ 1 & 1 & 3 \end{pmatrix}.$$

It is given that $\mathbf{A}$ is singular.

(a) Show that $\mathbf{CAB} = \begin{pmatrix} 3 & -7 \\ -9 & 3 \end{pmatrix}$. [5]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(b) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by **CAB**. [5]

[illegible]

Topical questions | 40 questions

25. Question part 2/2 | 9231 Oct-Nov 2023 P1 V3 Q5

[illegible]

(c) The matrices $\mathbf{D}$, $\mathbf{E}$ and $\mathbf{F}$ represent geometrical transformations in the x - y plane.

- **D** represents an enlargement, centre the origin.
- **E** represents a stretch parallel to the x -axis.
- **F** represents a reflection in the line $y = x$.

Given that $\mathbf{CAB} = \mathbf{D} - 9\mathbf{EF}$, find $\mathbf{D}$, $\mathbf{E}$ and $\mathbf{F}$. [5]

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Topical questions | 40 questions

26. Question part 1/2 | 9231 May-June 2024 P1 V1 Q4

4 The matrix **M** is given by $\mathbf{M} = \begin{pmatrix} \frac{1}{2} & -\frac{1}{2}\sqrt{3} \\ \frac{1}{2}\sqrt{3} & \frac{1}{2} \end{pmatrix} \begin{pmatrix} 14 & 0 \\ 0 & 1 \end{pmatrix}$.

- (a)** The matrix $\mathbf{M}$ represents a sequence of two geometrical transformations in the x - y plane.

Give full details of each transformation, and make clear the order in which they are applied. [4]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

- (b) Write $\mathbf{M}^{-1}$ as the product of two matrices, neither of which is $\mathbf{I}$. [2]

[illegible]

Topical questions | 40 questions

(c) Find the equations of the invariant lines, through the origin, of the transformation represented by $\mathbf{M}$. [5]

[illegible]

- Given that the area of triangle DEF is 28 cm^2 , find the area of triangle ABC . [2]

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Topical questions | 40 questions

4 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} \frac{1}{2} & -\frac{1}{2}\sqrt{3} \\ \frac{1}{2}\sqrt{3} & \frac{1}{2} \end{pmatrix} \begin{pmatrix} 14 & 0 \\ 0 & 1 \end{pmatrix}$.

- Give full details of each transformation, and make clear the order in which they are applied. [4]

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- This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(c) Find the equations of the invariant lines, through the origin, of the transformation represented by **M**. [5]

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(d) The triangle *ABC* in the *x-y* plane is transformed by **M** onto triangle *DEF*.
Given that the area of triangle *DEF* is 28 cm², find the area of triangle *ABC*. [2]

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Topical questions | 40 questions

28. Question part 1/2 | 9231 May-June 2024 P1 V3 Q1

1 The matrix $\mathbf{A}$ is given by

$$\mathbf{A} = \begin{pmatrix} k & 1 & 0 \\ 6 & 5 & 2 \\ -1 & 3 & -k \end{pmatrix},$$

where k is a real constant.

(a) Show that $\mathbf{A}$ is non-singular. [3]

[illegible]

(b) Given that $\mathbf{A}^{-1} = \begin{pmatrix} 3 & 0 & -1 \\ 1 & 0 & 0 \\ -\frac{23}{2} & \frac{1}{2} & 3 \end{pmatrix}$, find the value of k . [2]

[illegible]



Topical questions | 40 questions

3 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 7 & 0 \\ 0 & 1 \end{pmatrix}$.

- Give full details of each transformation, and make clear the order in which they are applied. [4]

[illegible]

-
- This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the entire width of the page. There are no margins, text, or other markings present.

This image shows a full page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice. There are no margins, text, or other markings on the page.

(c) Given that the area of triangle PQR is 35 cm^2 , find the area of triangle DEF . [2]

This image shows a full page of white paper with ten horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and extend across the width of the page. There is no handwriting or other markings on the paper.

Topical questions | 40 questions

30. Question part 1/2 | 9231 Oct-Nov 2024 P1 V1 Q1

- (a) Show that $\mathbf{M} = \begin{pmatrix} k & k \\ 0 & 1 \end{pmatrix}$. [4]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

- Find, in terms of k , the equation of this line. [3]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Topical questions | 40 questions



(c) Find, in terms of k , a matrix which transforms P onto S . [1]

[illegible]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Topical questions | 40 questions

31. Question part 1/2 | 9231 Oct-Nov 2024 P1 V2 Q4

$$\mathbf{A} = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \\ 3 & 2 & 5 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 0 & -2 \\ -1 & 3 \\ 0 & 0 \end{pmatrix} \text{ and } \mathbf{C} = \begin{pmatrix} -2 & -1 & 1 \\ 1 & 1 & 3 \end{pmatrix}.$$

- [illegible]

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- This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.

Topical questions | 40 questions

[illegible]

(c) Give full details of the transformation represented by $\mathbf{M}$. [2]

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.....

.....

(d) Find the matrix $\mathbf{N}$ such that $\mathbf{NM} = \mathbf{CAB}$. [3]

[illegible]

Topical questions | 40 questions

32. Question part 1/2 | 9231 Oct-Nov 2024 P1 V3 Q1

- (a) Show that $\mathbf{M} = \begin{pmatrix} k & k \\ 0 & 1 \end{pmatrix}$. [4]

[illegible]

- Find, in terms of k , the equation of this line. [3]

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Topical questions | 40 questions



(c) Find, in terms of k , a matrix which transforms P onto S . [1]

[illegible]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Topical questions | 40 questions

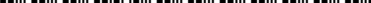
4 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{pmatrix}$, where $0 < \theta < 2\pi$.

- State the type of each transformation, and make clear the order in which they are applied. [2]

[illegible]

- [illegible]

Topical questions | 40 questions

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Topical questions | 40 questions

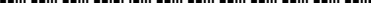
4 The matrix $\mathbf{M}$ is given by $\mathbf{M} = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{pmatrix}$, where $0 < \theta < 2\pi$.

- State the type of each transformation, and make clear the order in which they are applied. [2]

[illegible]

-
- This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Topical questions | 40 questions

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting or typing. There are no margins, text, or other markings on the page.

Topical questions | 40 questions

35. Question part 1/2 | 9231 May-June 2025 P1 V3 Q1

- 1** The matrix $\mathbf{M}$ represents the sequence of two transformations in the x - y plane given by a stretch parallel to the x -axis, scale factor 14, followed by a rotation anticlockwise about the origin through angle $\frac{1}{3}\pi$.

(a) Show that $2\mathbf{M} = \begin{pmatrix} 14 & -\sqrt{3} \\ 14\sqrt{3} & 1 \end{pmatrix}$. [4]

- (b) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by $\mathbf{M}$. [5]

Topical questions | 40 questions

This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page, typical of notebook or legal stationery. There are no margins, text, or other markings on the page.

(c) Find the matrix which transforms P onto S . [2]

[illegible]

Topical questions | 40 questions

36. Question part 1/2 | 9231 May-June 2025 P1 V4 Q5

- 5** The matrix $\mathbf{M}$ represents a sequence of two transformations in the x - y plane given by a one-way stretch in the x -direction, scale factor 3, followed by a reflection in the line $y = x$.

(a) Find $\mathbf{M}$. [3]

[illegible]

(b) Give full details of the geometrical transformation in the x - y plane represented by $\mathbf{M}^{-1}$. [3]

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The matrix $\mathbf{N}$ is such that $\mathbf{MN} = \begin{pmatrix} 1 & 2 \\ 3 & 2 \end{pmatrix}$.

(c) Find N . [3]

[illegible]

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

36. Question part 2/2 | 9231 May-June 2025 P1 V4 Q5



- (d) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by **MN**. [5]

[illegible]

Topical questions | 40 questions

37. Question part 1/2 | 9231 Oct-Nov 2025 P1 V1 Q2

2

and $\mathbf{B} = \begin{pmatrix} 1 & 0 \\ \frac{3}{2} & 1 \end{pmatrix}$.

- [2]

- [2]

The triangle DEF in the x - y plane is transformed by $\mathbf{AB}$ onto triangle PQR .

- [2]

[illegible]

9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

37. Question part 2/2 | 9231 Oct-Nov 2025 P1 V1 Q2



- (d) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by **AB**. [5]

[illegible]

Topical questions | 40 questions

38. Question part 1/2 | 9231 Oct-Nov 2025 P1 V2 Q4

4 Let k and m be non-zero constants. The matrices **A**, **B** and **C** are given by

$$\mathbf{A} = \begin{pmatrix} 0 & 1 \\ -1 & 1 \\ 1 & 1 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} k & 0 \\ 0 & m \end{pmatrix} \text{ and } \mathbf{C} = \begin{pmatrix} 2 & -1 & 1 \\ 1 & 1 & 2 \end{pmatrix}.$$

- (a) Give full details of the geometrical transformation in the x - y plane represented by the matrix $\mathbf{B}$ in each of the following cases.

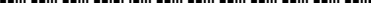
- (i) $m = 1$ [2]

- (ii) $m = k$ [2]

- (b) Show that the matrix $\mathbf{ABC}$ is singular. [6]

[illegible]

Topical questions | 40 questions

[illegible]

Topical questions | 40 questions

39. Question part 1/2 | 9231 Oct-Nov 2025 P1 V3 Q2

2 The matrices **A** and **B** are given by

$$\mathbf{A} = \begin{pmatrix} 1 & \frac{3}{2} \\ 0 & 1 \end{pmatrix} \text{ and } \mathbf{B} = \begin{pmatrix} 1 & 0 \\ \frac{3}{2} & 1 \end{pmatrix}.$$

- (a)** Give full details of the geometrical transformation in the x - y plane represented by $\mathbf{A}$. [2]

[illegible]

- (b)** Give full details of the geometrical transformation in the x - y plane represented by **B**. [2]

The triangle DEF in the x - y plane is transformed by $\mathbf{AB}$ onto triangle PQR .

- (c) Show that the triangles DEF and PQR have the same area. [2]

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9231 Further Mathematics Paper 1 - Matrices

Topical questions | 40 questions

39. Question part 2/2 | 9231 Oct-Nov 2025 P1 V3 Q2



- (d) Find the equations of the invariant lines, through the origin, of the transformation in the x - y plane represented by **AB**. [5]

[illegible]

Topical questions | 40 questions

40. Question part 1/2 | 9231 Oct-Nov 2025 P1 V4 Q5

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[illegible]



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- $$m^2 \sin\left(\frac{1}{12}\pi\right) + 2m \cos\left(\frac{1}{12}\pi\right) - \sin\left(\frac{1}{12}\pi\right) = 0$$

[illegible]